

Commonwealth of Massachusetts
Department of Telecommunications and Energy
Fitchburg Gas and Electric Light Company
Docket No. D.T.E. 02-24/25
Record Request Response

Record Request No.: AG-RR-54 (Electric)

- a. For Authorizations 1053 and 1068, please describe any efforts by the Company to recover the costs of the defective equipment from the manufacturer.
- b. Indicate the amount of these costs included in plant in-service.

Response:

It was perhaps a poor choice of words to describe the problem as "defective equipment". To use an analogy, let's say you purchase a car, drive it for 10 years, and put 125,000 miles on it, whereupon the engine fails due to a blown head gasket. In this case, the car is clearly beyond any reasonable warranty period the manufacturer is going to honor. It could even be argued that the car achieved its design life. However, if investigation reveals that this particular car/engine has a known issue with blown head gaskets after 100,000 miles, you could also conclude that this represents a design defect. Clearly, you would not be aware of this issue when the car was purchased. The only alternative available to the owner is to repair the engine.

The same situation applies to the replacement of the tap changers covered by authorizations 1053 and 1068. The transformers and tap changers covered by these authorizations were purchased from a very reputable manufacturer. At the time of purchase, there was no reason to suspect that the tap changers would ultimately experience problems. The transformers themselves (of which the LTC is a part) were approximately 14 - 19 years old at the time the tap changers were replaced. The warranty on new power transformers is typically 1 - 5 years, as specified during the original RFQ and bid selection.

The concern initially involved only the Townsend substation transformer, which was manufactured in 1983. After identifying the problem at Townsend, it was determined that an identical tap changer was in-service at Beech Street, which was manufactured in 1987. An investigation was conducted and it was determined that these tap changers were known within the industry to have a very specific problem. Hundreds of these particular tap changers have been replaced or refurbished by utilities, demonstrating that the problem was not unique to Fitchburg. As a result of the engineering investigation, a decision was made to replace both tap changers immediately. Copies of the applicable investigations are included as Attachment 1 AG-RR-54 and Attachment 2 AG-RR-54.

FG&E did not make any efforts to recover the costs of the tap changer replacement from the manufacturer as both units were well beyond the applicable warranty periods, and well beyond any expectation of a commercial settlement.

The total amount included in plant in-service for these two repairs is \$104,804.

Person Responsible: Mark H. Collin

Townsend Substation
LTC Repair Recommendations
January 11, 2001

DTE 02-24/25 (Electric)
Attachment 1, AG-RR-54
Page 1 of 3

Background:

System planning studies for the FG&E transmission system showed that the no load tap setting for the Townsend Substation transformer should be changed from the 63.75 kV tap to the 67.725kV tap. This decision was supported by the fact that the load tap changer (LTC) of this transformer has been operating in the lower range for the recent past.

Upon re-energizing the transformer (without load), there was a noise noticed in the LTC compartment. The noise was described as "bacon slowly frying". The noise that was heard was only noticeable when the transformer went through the neutral tap and went to the raise condition. In the lower range, the noise was not noticed. This was a good find by the operations personnel at FG&E.

Once the source of the noise was narrowed down to the LTC compartment, the transformer was de-energized. At that point in time, it was thought that the reversing switch may be causing the noise.

Information Gathering:

The LTC on the Townsend Substation transformer is a GE LRT-200-2. Several calls were placed to the following transformer consulting/repair facilities:

Weidmann
S.D. Meyers
High Voltage Supply
Normandy Machine Inc.

Upon describing the problem to each of these companies, they all provided the same possible cause of the problem. The GE LRT-200 series of tap changers have a known problem. The insulating cylinder (as shown in the attached picture) is made of a paper-like material. This LTC is a free breathing device, therefore moisture is constantly taken into and released from the LTC compartment.

Over time, the insulating cylinder becomes saturated to a point that dielectric capabilities are no longer high enough to provide the insulation required. The moisture leads to tracking or dissipation along the insulating cylinder.

This is a known defect with this particular LTC. All of the companies contacted expressed that this LTC is only good for about 20 years. At that point in time, they should be replaced and/or rebuilt with a new insulating cylinder, switches and vacuum bottle. Within the past 2 years, one of these repair facilities have rebuilt 300 of the LRT-220 LTC mechanisms.

LTC Disassembly:

With this information, it was determined that the best approach to take would be to drain the oil from the LTC and take a look inside. Upon removing the door of the LTC, tracking was found on the inside of the insulating cylinder.

Upon further investigation, it was determined that the center phase reversing switch was tracking onto the insulating cylinder. This was evident due to the excessive amount of carbon byproducts and copper particles. Upon attempting to wipe the carbon off of the cylinder, it was determined that the cylinder itself had been burned in the process.

Townsend Substation
LTC Repair Recommendations
January 11, 2001

To further investigate the probability that this was indeed the source of the noise, the LTC was operated through the neutral position. Upon moving the LTC through neutral, the switch aligned perfectly with the spot where the tracking had occurred. The attached pictures show what has been described.

At that point in time, the LTC was resealed and the oil was not put back into the LTC compartment.

Recommendation:

Upon taking with the various transformer companies, there are three options that can be taken.

OPTION 1:

This option consists of obtaining the replacement parts from one of the companies. Upon receiving the parts, an FG&E crew would remove the LTC mechanism from the tank and bring it back to the shop. The FG&E crew would then proceed to rebuild the LTC with the parts kit is had purchased.

This option poses several concerns. The first concern is that the operations personnel have not had much if any experience in rebuilding LTCs. The rebuilding process includes some very finite alignment be completed. In addition to the alignment, the timing of the device needs to be tested. FG&E does not have the equipment necessary to complete the timing tests required. This could turn into a long project and leave the system exposed with the mobile transformer installed at Townsend Substation.

Cost	\$11,510.00
Labor	2 weeks
Timeframe	6-8 weeks

OPTION 2:

This option consists of removing the LTC mechanism from the transformer and shipping to a repair facility. The repair facility has quoted a 4-6 week turn around.

This option leaves the Townsend transformer out of commission for at least 5-7 weeks until the LTC mechanism can be reinstalled. This option leaves the system in a compromised situation with the mobile installed at Townsend Substation. The back up to the mobile is the spare transformer located at FG&E. This option would be a long, drawn out process and leave the system where it may incur a lengthy outage.

Cost	\$16,997.00
Labor	3 days
Timeframe	4-6 weeks

OPTION 3:

Option 3 consists of obtaining a rebuilt LTC from one of the transformer companies and completing a swap with the mechanism from the Townsend transformer. At least one of the companies always keep extra LTC mechanisms that they have already rebuilt so it can supply them at a moment's notice.

This option will return the system back to normal as soon as possible. The mechanism will arrive fully tested and aligned so that the only requirement would be to replace the old mechanism with the new mechanism.

Townsend Substation
LTC Repair Recommendations
January 11, 2001

Cost	\$19,996.00
Labor	3 days
Timeframe	2 weeks

LTC Dissolved Gas-in-Oil Analysis:

Since the last LTC oil analysis was completed, DeltaX (the analysis software) has updated the LTC analysis rules based upon historical information specific to individual LTCs. Upon evaluating the most recent oil results with the new analysis rules, the results show a very high level of acetylene. This suggest arcing under oil. Since an LRT-200-2 LTC uses vacuum bottle technology, there should be no combustible gases present within the oil. Combustible gases of any level should be a cause for concern with respect to this sample. The equipment condition code for this particular LTC is a 4 (most severe).

The other LRT-200-2 LTC is located at Beech St. substation. Knowing that the same condition could exist in this LTC, the most recent oil sample was analyzed. The results once again suggest that arcing under oil is present. It appears that the same condition exists as with the Townsend Substation LTC.

Recommendation:

It is recommended to take the approach described in Option 3. This would require the least amount of intervention on the part of operations as well as provide a mechanism that has already been tested and aligned. This option would also create the least impact to the FG&E system. The system could be placed back to its normal configuration in a more timely manner and the mobile could then be released.

In addition to this LTC, the LTC at Beech Street Substation is the same type. Based upon the results of the dissolved gas-in-oil analysis, it appears that the Beech Street LTC might be in trouble. It is recommended to modify the maintenance cycle to move Beech Street up to the front. Since this is a know problem, it would be in the best interest of the company to replace/repair this LTC because it could cause a rather lengthy outage.

Ordering Information:

Normandy Machine Company, Inc
250 Industrial Drive
Troy, MA 63379
Phone (636) 528-8913
Fax (636) 528-8937

Quote #: 23848

Catalog #: 3522410000

Contact Person: Ernie Bean or Jerry Woodruff

Description: Remanufactured GE LRT-200-2 complete with spun tube and G-10 shafts, upgrade bypass, G-10 reverse switch lift arm, all necessary repairs to meet or exceed OEM specifications, NMC design one, FG&E to return replaced LTC for exchange.

Delivery: 2 weeks ARO

Price: \$19,996.00

Beech Street Substation
LTC Repair Recommendations
February 19, 2001

DTE 02-24/25 (Electric)
Attachment 2, AG-RR-54
Page 1 of 2

Summary:

FG&E has two transformers equipped with LRT-200-2 LTC mechanisms. In January of 2001, the Townsend transformer LTC was found to be in danger of failing. It was determined at that time, based upon recommendations from transformer repair facilities, that the LTC mechanism should be replaced as soon as possible. This project was completed under Auth # 1503 and CWO # 2608.

The Beech Street transformer is equipped with the same model LTC mechanism. Based upon all of the information that can be gathered, without taking the transformer out of service, this LTC mechanism should also be replaced to prevent an outage.

Background:

On January 11, 2001, FG&E operations found a problem with the LTC mechanism on the Townsend Substation transformer. The insulating cylinder in the LTC mechanism is manufactured from a paper-like material.

The paper-like material tends to absorb moisture. Over time, the insulating cylinder becomes saturated to a point which the dielectric capabilities are no longer high enough to provide the insulation required. The moisture leads to tracking along the insulating cylinder.

This is a known defect with this particular LTC. Many transformer repair companies were contacted during the Townsend outage. All of the repair companies contacted expressed that this LTC is only good for about 20 years. At that point in time, they should be replaced and/or rebuilt with a new insulating cylinder, switches and vacuum bottles. Within the past 2 years, one repair facility has rebuilt approximately 300 of the LRT-220 LTC mechanisms.

The Beech Street substation transformer is the only additional transformer on the FG&E system equipped with this model of LTC. Based upon industry information, the condition of the Beech Street transformer LTC has been evaluated. This document details the finding and recommended action steps.

LTC Dissolved Gas-in-Oil Analysis:

Since the previous LTC oil analysis was completed, DeltaX (the analysis software) has updated the LTC analysis rules based upon historical information specific to individual LTCs. Upon evaluating the most recent oil results with the new analysis rules, the results show a very high level of Ethylene and abnormal levels of Hydrogen, Carbon Monoxide and Carbon Dioxide.

The very high levels of Ethylene suggest an active fault while the abnormal levels of Hydrogen, Carbon Monoxide and Carbon Dioxide suggest coking or overheating. All of these results suggest arcing under oil. Since an LRT-200-2 LTC mechanism uses vacuum bottle technology, there should be no combustible gases present within the oil. Combustible gases of any level should be a cause for concern with respect to this sample. The equipment condition code for this particular LTC is a 4 (most severe).

Purchasing Option:

Upon evaluating several different option during the Townsend transformer LTC project, the most cost effective option consists of obtaining a rebuilt LTC from one of the transformer repair facilities and completing a swap with the mechanism from the Beech Street transformer. At least one of the transformer repair companies always keep extra LTC mechanisms that they have already rebuilt so it can supply them at a moment's notice.

Beech Street Substation
LTC Repair Recommendations
February 19, 2001

DTE 02-24/25 (Electric)
Attachment 2, AG-RR-54
Page 2 of 2

This option will minimize the repair time and return the system back to normal as soon as possible. The mechanism will arrive fully tested and aligned so that the only requirement would be to replace the old mechanism with the new mechanism. This labor estimate includes all of the switching time, mobile setup time, removal of existing LTC mechanism, installation of the new LTC mechanism, and testing.

LTC Cost	\$19,996.00
Labor	100 crew hours
Project Duration	1 month (approximate)

Recommendation:

It is recommended, based upon industry information as well as information that has been gathered on the Beech Street LTC mechanism, that this project be submitted as a 2001 non-budget project.

It is recommended to take the approach described above. This solution is the most cost effective and provides a mechanism that has already been tested and aligned. This option would also create the least impact to the FG&E system. The system could be placed back to its normal configuration in a more timely manner and the mobile would then be available sooner.